

# Spin-CP studies of the new boson for Snowmass

**Study kinematic distributions of  $X \rightarrow VV \rightarrow 4$  fermions to extract tensor amplitude structure of production and decay of the new boson.**

using JHU generator and MELA method:

- <http://www.pha.jhu.edu/spin/>
- Phys. Rev. D 81, 075022 (2010)
- Phys. Rev. D 86, 095031 (2012)

Evaluate the sensitivity at future pp and (possibly) e+e- colliders for:

(gen-level studies with smearing+acceptance cuts)

## □ CP mixing studies assuming spin 0

$$A(X_{J=0} \rightarrow V_1 V_2) = v^{-1} \left( g_1 m_V^2 \epsilon_1^* \epsilon_2^* + g_2 f_{\mu\nu}^{*(1)} f^{*(2),\mu\nu} + g_4 f_{\mu\nu}^{*(1)} \tilde{f}^{*(2),\mu\nu} \right)$$

with present LHC statistics pure 0- ruled out ( $g_i=0$  for  $i \neq 4$ ) -> next steps

- test **mixed hypotheses** with more than one  $g_i \neq 0$  (with interference included)
- **fit directly the fractions and phases of  $g_i$**  from kinematic distributions  
Eg: 0.08 precision expected on  $g_4$  fraction with 300 fb<sup>-1</sup> at LHC

## □ Exotic spin scenarios (similar, more complex, formula as above available in cited papers for spin>0)

most basic (minimal couplings) scenarios under test at LHC -> next steps

- test wide range of **scenarios** (identify the ones **with kinematics very similar to 0+ SM case**)
- more model independent approach: **production-independent spin tests**  
**mixing-independent spin tests**